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DESIGN AND ANALYSIS OF MODULAR MULTILEVEL INVERTER FOR SOLAR PHOTOVOLTAIC APPLICATIONS

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ABSTRACT

In this paper, we introduces a modular multilevel converter fed from solar cell which is used to reduce the number of semiconductor Switches. MMC intends design in both control and power circuits to provide corresponding output voltage levels by appropriate switching sequences. Hence to obtain a 15-level converter, the conventional method requires 28 switches and in binary mode 12 switches are needed. In trinary mode with the same 12 switches, 27 levels can be obtained whereas in Modular Multilevel Converter only 7 switches are employed to achieve 15 levels.

This converter can be used to integrate the Photovoltaic system into Grid, with satisfying the grid requirements such as frequency,phase angle and amplitude of the Grid voltage. Fifteen level proposed Modular Multilevel Converter is simulated using Matlab/Simulink environment and the corresponding results are presented in this paper.

KEYWORDS: Modular Multilevel Converter, PVsystem, Solar Cells, Matlab/ simulink

INTRODUCTION

Renewable energy sources are alternatives to our conventional energy sources which are limited and exhausted such as fossil fuels e.g. oil, coal, gas that are not renewable. Many renewable energy sources are existing solar, hydro, biomass, wind, geothermal and ocean power .Among PV has the advantage of clean and no pollution, no fuel cost, abundance of sunlight ,easy installation, low maintenance etc. So, PV systems are attracting attention in the world.

Multilevel converter using these PV cells provides a suitable solution for medium and high power systems .This system synthesis a output voltage which allows a reduction of harmonic content in voltage and current waveforms. Multilevel refers to the multiple connections of individual converters termed as 'stages' to provide the output voltage with required 'levels'. Increasing the number of levels will result in the reduction of harmonic distortion. This paper proposes a new type of multilevel Converter which requires less number of DC sources and switches compared to Cascaded H-bridge MUs. THD of the output voltage is also less when compared to the conventional MUs. By using this converter we can efficiently integrate the PV into the conventional existing power grid.

BLOCK DIAGRAM

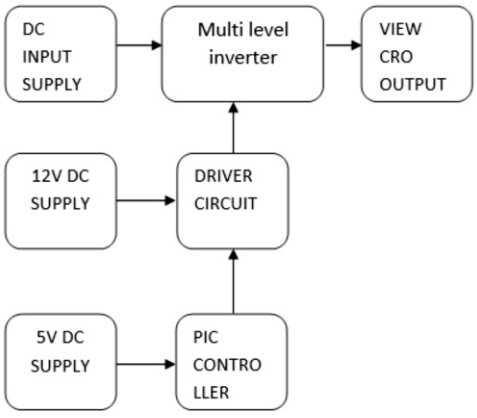


Fig. block diagram of modular multilevel inverter

WORKING

DRIVER CIRCUIT: Driver circuit is used to provide 5 to 12 volts to switch the MOSFET Switches of the inverter. The voltage amplified by driver from microcontroller which is 5volts. And it has an optocoupler for isolating purpose. So damage to MOSFET is prevented The driver unit contains the following important units like Optocoupler , Totem pole , Capacitor, Supply Diode, Resistor.

PIC CONTROLLER: Here we are using PIC 16F877A for producing switching pulses to multilevel inverter. So as to use these vectors which do not generate any common mode voltage at the inverter poles. It is used to eliminate unbalancing of capacitor voltage. Driver circuit drive the microcontroller so as to boost the voltage triggering signal to 9V.Due to direct passing of 230V supply to avoid any damage to microcontroller it we provide an isolator in the form of op to coupler in the same driver circuit.

MOSFET SWITCH-IRFP250N: In this circuit MOSFET switch is connected to the main circuit. Here we have two switches namely 1)Main switch 2)Auxiliary switch

Micro controller PIC16F877A gives pulse to this switches through a driver circuit. The 5V pulse is generated in PIC which is sent to driver circuit, these signal is amplified to about 12V DC, and send to mosfet switches.

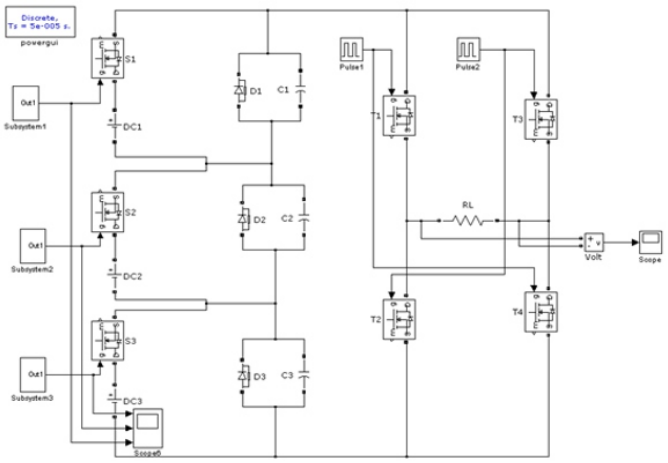
MULTILEVEL POWER CONVERTER:

Three types of multilevel converter used in industries are cascaded H-bridges converter with separate dc sources, diode clamped, and flying capacitors. Multilevel converter is power electronic circuit that could operate in an inverter or rectifier mode.

CASCADED H-BRIDGES:

In single-phase structure of an m-level cascaded , Each separate dc source (SDCS) is connected to a single-phase full-bridge, or H-bridge, inverter. Each inverter level can generate three different voltage outputs, +Vdc, 0, and –Vdc by connecting the dc source to the ac output for which different combinations of the four switches, S1, S2, S3, and S4 are used. The m number of output phase voltage levels in a cascade inverter is defined by m = 2s+1, where s is the number of separate dc so

SIMULATION RESULT



OUTPUT VOLTAGE WAVEFORM

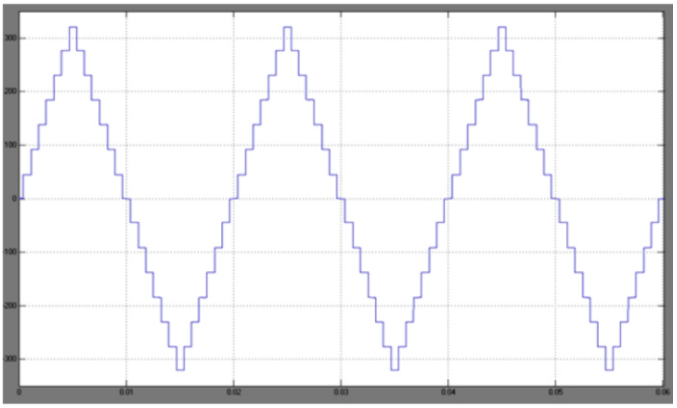


Fig. Output voltage waveform

CONCLUSION

The power quality improvement for a solar fed CMLI with reduced number of semiconductor switches is investigated. With only 7 switches in MMC mode the required 15 level output is achieved. The mathematical model for solar PV is carried out and it is considered as the input to the inverter stage. Proposed method provides the advantages which include reduced THD, simple design, less cost minimum computational complexity and the absence of transformers, filter circuit ,boost converters, detailed look-up table. Simulation study is carried out for various levels and comparison has been made.

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